

Selenium's Secrets Probed in New Study

PEGGY GREB (K9823-1)



Chemist Chris Hawkes prepares a hair specimen from a volunteer to analyze its selenium content. Hair can provide a history of dietary selenium intakes from a couple of weeks to many months in the past.

Tomorrow's breads, pastas, and other flour-based foods might be specially enriched with selenium—an essential nutrient. But more research into the activity of selenium in our bodies needs to be done before the United States embarks on fortifying foods with this trace element.

That's why ARS research chemist Chris Hawkes is leading an innovative investigation of moderately high doses of selenium. He is looking at the effects on human cardiovascular health, immune function, and reproductive health. Hawkes is at the ARS Western Human Nutrition Research Center at Davis, California.

The selenium experiment, now in its second phase, will provide new, detailed information about this mineral. More than 30 healthy men aged 18 to 45 are participating as volunteers in this study.

For 1 year, half the volunteers will take a daily capsule that provides five and one-half times the Recommended Dietary Allowance of selenium in the form of high-selenium yeast. The other half will receive a daily placebo—a capsule that looks the same but contains only yeast and no selenium.

At regular intervals, the men will visit the center to provide samples of blood, urine, semen, and other specimens for laboratory tests. They will also receive tests of cardiovascular function and several other health indicators. In addition, they will turn in detailed records of their exercise, general health, and the foods they have eaten during specific 3-day periods.

"This multiphase, multiple-variable experiment will give us a more detailed look at selenium's activities over a longer period than the first phase of our study," says Hawkes. The first phase included 11 volunteers who lived at the center for 120 days and ate meals specially prepared for them. In the current phase of the study, volunteers live at home with a free choice of what to eat. They come to the center only for testing.

Seafood and meats and grains from regions with selenium-rich soils are good sources of this mineral. Other sources include dairy products and vegetables.

Scientists have known for years that selenium is needed for proper growth and reproduction in animals. This work with animals has also indicated that selenium is critical to keeping the thyroid active and functioning properly. Too, it is a powerful antioxidant that protects cells from oxidation byproducts known as peroxides. But selenium still holds secrets.

For example, Hawkes says, recent studies, done elsewhere with laboratory animals raised on selenium-deficient feed, have suggested that selenium helps fight cardiovascular disease. Arteries in those animals did not properly expand and contract. Arteries are the stretchy vessels that carry oxygenated blood away from the heart, out to the rest of the body.

That expansion and contraction, or vascular responsiveness, is vital for maintaining a healthful flow of blood. "In our study,

we are measuring the changes in vascular responsiveness of these volunteers by regularly monitoring the diameter and flow rate of the brachial artery in the upper arm,” says Hawkes. “This is a standard test of vascular responsiveness.

“We use an inflated blood pressure cuff on the forearm to temporarily block the flow of blood. Then we release the cuff and use an ultrasound device to see and measure the response of the artery. In a person with good vascular tone, the artery will quickly expand once the cuff is removed. We think a selenium-containing enzyme may be involved in signaling the artery to expand.”

For these cardiovascular tests, Hawkes is collaborating with Lawrence Laslett, M.D., a cardiologist at the University of California at Davis School of Medicine.

Says Hawkes, “Selenium is already being tested by medical professionals to fight AIDS. But the exact interaction between selenium and the immune system in healthy people—such as those in our study—isn’t known.”

In phase one of Hawkes’s study, he found that selenium increased the antibody response to vaccinations and improved the growth of lymphocytes, a type of white blood cell. Hawkes did that work with research chemist Darshan S. Kelley of the Western Human Nutrition Research Center.

In this newest phase of the study, Hawkes is monitoring a comprehensive panel of indicators of immune function in the blood to track selenium’s effects. He is also collecting data from skin sensitivity tests for a variety of allergens and is asking volunteers to keep a personal “sniffle diary” to document colds and other respiratory infections.

He is analyzing the volunteers’ reproductive health because the first phase of the study indicated that a high-selenium regimen might lower sperm motility—that is, the ability of sperm to move or swim.

“We want to see if the same effect occurs in volunteers who are living at home instead of at our research facility,” says Hawkes. Studies at other institutions have shown that very high levels of selenium result in lower sperm motility in laboratory animals. But results from human studies have been inconsistent, Hawkes says. His collaborator for the sperm motility studies is urologist Paul J. Turek, M.D., at the University of California at San Francisco.

Another apparent effect of high selenium that occurred in the first phase of the study was a small but statistically significant average weight gain of approximately 2 pounds. The weight gain, Hawkes says, accompanied a 25-percent decrease in active thyroid hormone. That’s why, in this phase of the study, Hawkes and his co-researchers are monitoring changes in weight, thyroid hormones, and body composition—the relative amount of fat and lean tissue (muscle, bone, and water). He is doing this work with exercise physiologist Marta

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As part of a study on selenium’s effects, phlebotomist Evelyn Holguin draws a blood sample from a volunteer. Study participants provide samples about every 6 weeks for biochemical, genetic, and immunological analysis.

Animal studies indicate that **selenium** is critical to keeping the thyroid active and functioning properly. It’s also a powerful antioxidant. But selenium still holds secrets.

D. Van Loan and with research chemist Nancy L. Keim, both of the nutrition center.

Hawkes expects to see variations in the way the healthy men in his study respond to selenium. Genes likely play a significant role in these variations. So Hawkes and pathologist Jeffrey P. Gregg, M.D., of the University of California at Davis Medical Center, are analyzing genetic material in the volunteers’ blood samples. Each sample is analyzed for 12,625 genes.

“We are looking for differences in the expression of genes due to selenium,” says Hawkes. “This work could provide valuable clues to the inner workings of selenium.”—By **Marcia Wood**, ARS.

This research is part of Human Nutrition, an ARS National Program (#107) described on the World Wide Web at <http://www.nps.ars.usda.gov>.

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